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The effects of n-3 LC-PUFA supplementation on hand-eye coordination

Seferoğlu Funda*, Erman K. Alparslan, Şahan Asuman

School of Physical Education and Sports,Akdeniz University, Dumlupinar Avenue, 07058, Antalya, Turkey

Abstract

The aim of this study was to investigate the effects of n-3 LC-PUFA (omega3 long-chain unsaturated fatty acid) supplementation on hand-eye coordination. This research was a single-blind placebo-controlled trial. Fifty three individuals (10,89±1,57 years old) who had never played tennis before took part in the study. They were randomly allocated to three groups. Omega group received n-3 LC-PUFA (670 mg · day-1; n=21); placebo group received olive oil (670 mg · day-1; n=18) during 16 weeks; and control group. All of the groups (omega, placebo and control) joined to the tennis trainings which involved 3 hours per week for 16 weeks. Individual's hand-eye coordination was evaluated before and after 16 weeks tennis trainings with two hand-eye coordination test battery. The data were evaluated with repeated measures analysis of variance and also with paired simples T-Test. The results show that there were no significant differences between groups (p>0,05), but omega (p=0,004) and placebo (p=0,006) groups has significant improvement on their hand-eye coordination in spite of control group (p=0,086). Consequently, it can be said that n-3 LC-PUFA supplementation might be improve hand-eye coordination of children but tennis training also efficient on hand-eye coordination.

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Keywords: n-3 LC-PUFA; coordination; nutrition; tennis.

1.Introduction

Tennis requires high level of coordination (1,2). The term "coordination" is defined as the ability to perform complex motor exercises (3,4). Normal eye–hand coordination involves the synergistic function of several sensory motor systems, including the visual system, vestibular system, proprioception, and the eye, head, and arm control systems, plus aspects of cognition like attention and memory (5).

n-3 LC-PUFAs have been associated with the integrity of the Central Nervous System (CNS) and two of the longer-chain omega-3 fatty acids eicosapentaenoic acid (EPA, 20:5) and docosahexaenoic acid (DHA, 22:6) seem to be the most beneficial to the CNS (6).

*Funda SEFEROĞLU: +90-242-310 6845
E-mail: fundaz@akdeniz.edu.tr

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Docosahexaenoic acid is the most abundant omega-3 fatty acid in the brain. Humans obtain DHA either as DHA itself or from its precursor, α-linolenic acid (18:3n-3), but the conversion of α-linolenic acid to DHA is limited (7). n-3 LC-PUFA supplementation affects brain cognitive functions such as learning, coordination, problem solving ability and motor skill by improving the micro and macro structure of the brain (8).

There is considerable interest in the role that docosahexaenoic acid (DHA, 22:6n-3) plays in visual and cognitive development during infancy and childhood (5). The western diets are low in n-3 LC-PUFAs and individuals who consume inadequate energy, protein, vitamins, and minerals may be less able to metabolize long-chain PUFAs from dietary precursors, it may be that many children in both developed and developing countries are at risk of less than optimal intake of n-3 LC-PUFA. This in turn may compromise optimal brain and cognitive development. n-3 LC-PUFA in particular, may be important for the development of attention and problem solving, which are the functions that arise from the frontal lobes. There is some evidence that fatty acid metabolism may be implicated in a cluster of neurodevelopmental disorders, including attention deficit-hyperactivity disorder (ADHD), dyslexia, dyspraxia, and the autistic spectrum (6).

2.Material and methods

1.1. Subjects:

Forty girls (10,91±1,67 years old) and thirty-three boys (10,84±1,27 years old) totally fifty-three individuals (10,89±1,57 years old) participate to the study as a volunteer. The inclusion criteria were standardized health, willing participation, 10-12 age range, not receiving medication or vitamins, and never play tennis before. The exclusion criteria were sudden illness, coordination disorder, unwillingness to continue the study, not in the 10-12 age range, and ever played tennis before. All participants' parents/guardians gave written informed consent and participants gave informed assent prior to inclusion in the study. This research project has been approved by Akdeniz University School of Medicine Ethical Committee of Drug Research (approval number: 5822), Republic of Turkey Ministry of Health, General Directorate of Drug and Pharmacy (approval number: 60994) and Provincial Directorate of National Education (approval number: 01602).

Fifty-three individuals were randomly allocated to three groups. Omega group; to receive n-3 LC-PUFA (670 mg · day-1; n=21), placebo group; to receive olive oil (670 mg · day-1; n=18) and control group (n=14); to receive any thing during 16 weeks. All of the groups participate to the tennis trainings for 16 weeks.

Tennis training sessions lasting one hour, three times a week for 16 weeks and a total of 48 hours and same tennis education programme were scheduled for the three groups.

Tennis fundamental techniques, ground stroke, volley and service drills, were applied. Teaching of all the fundamentals was applied according to the principles 'easy to hard, simple to complicated, and known to unknown'.

1.2. Placebo and n-3 LC-PUFA application:

Fourteen fish oil capsules containing n-3 LC-PUFA or placebo capsules containing olive oil were given to the subjects weekly at the first training session of the week. The dose was a 335 mg capsule after two meals, giving a total dose of 670 mg/day/subject, for 16 weeks. Olive oil capsules which were applied as placebo were made out of capsules that had the same appearance and size as the n-3 LC-PUFA capsules. Each week, the project supervisor interviewed the parents and subjects to check that the participants had taken the capsules and whether they had any side effects.

1.3. Two hand-eye coordination (THEC):

This test applied with Two-Arm Coordination Test battery (Lafayette 32532). This is a test of motor coordination and learning which requires both arms to work together. The individuals' task is to move the metal pointer around the anodized star pattern without leaving the pattern. In the beginning individuals placed the stylus on the top point of the star. After "START" command, they began moving the stylus in a clockwise

direction (to the right) around the star. They were admonished for that the score is equally weighted for speed as well as accuracy. Therefore, they tried to move the stylus around the star as quickly as possible, made as few contacts (errors) as possible (9).

1.4. Statistical analysis:

Data are expressed as means ± standard deviation (S.D.). The differences between the groups and time-dependent changes in the groups were examined in statistical analysis. All data were normally distributed. Significance values (p) lower than 0.05 were considered as significant. Time-dependent changes of the three groups were examined with repeated measures.

3.Results

Table 1: THEC scores and significance between groups

	Omega (n=21)	O*P p	Placebo (n=18)	P*C p	Control (n=14)	C*A p
THEC pre	75,85±23,27	,991	76,87±25,77	1,000	76,81±21,98	,993
	,004*		,006*		,086	
THEC post	63,35±14,64	,935	61,17±22,44	,505	68,92±17,94	,685
time	$F_{(1,50)}$=21,702, p=0.000					
Group*time	$F_{(2,50)}$= 0,699, p=0.502					
group	$F_{(2,50)}$= 0,179, p=0.837					

*p<0.05

The groups showed improvement in THEC scores ($F_{(1.50)}$ =21,702, P=0.000). This improvement was determined in placebo (P=0.006) and omega (P=0.004) groups. The control group showed no significant differences between measurements of THEC (P>0.05). Also there was no significant difference between groups ($F_{(2.50)}$ = 0,179, P=0.837).

4.Discussion

The key to success in tennis is eye–hand coordination (1). Miall and colleagues report the most direct evidence from functional imaging that the cerebellum supports motor coordination. Its activity is consistent with roles in coordinating and learning to coordinate eye and hand movement (10). The variable two hand-eye coordination (THEC) measured the ability of hand-eye coordination. In this study the eye-hand coordination was impaired with tennis trainings in three groups. But there were any differences between groups its mean that n-3 LC-PUFA has no directly effect on eye-hand coordination.

n-3 LC-PUFA supplementation affects brain cognitive functions such as learning, coordination, problem solving ability and motor skill by improving the micro and macro structure of the brain (8). Many reliable studies investigate the effects of n-3 LC-PUFA with specific tests. The results of these studies demonstrate that n-3 LC-PUFA plays important role in abilities which are processed in frontal lobe and motor cortex of the brain (11,12). Coordination such as eye-hand coordination is a motor ability which is control by motor cortex of brain (3). In this study omega and placebo group showed more improvement in eye-hand coordination from other control group, but this differences not significant as statistically. Recent studies demonstrated the effects of n-3 LC-PUFA supplementation. Dunstan et al, were investigate the effects of n-3 LC-PUFAs on cognitive development in 98 pregnant individuals. In conclusion they found that maternal n-3 LC-PUFA supplementation during pregnancy may have potentially beneficial effects on the child's eye and hand coordination (13) Koletzko et al, were investigate the effects of n-3 LC-PUFAs on central nervous system in 1-11 years age range 36 children with Phenylketonuria. They were receiving 15mg/kg DHA or placebo for three months. At the end of the study they evaluate the visual functions, motor ability and coordination of children, and DHA group

significantly more improved than placebo group in terms of motor ability and coordination (14). The recent studies demonstrate that n-3 LC-PUFA effects cognitive and motor functions. But in this study we couldn't find any directly effects of n-3 LC-PUFA on coordination.

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